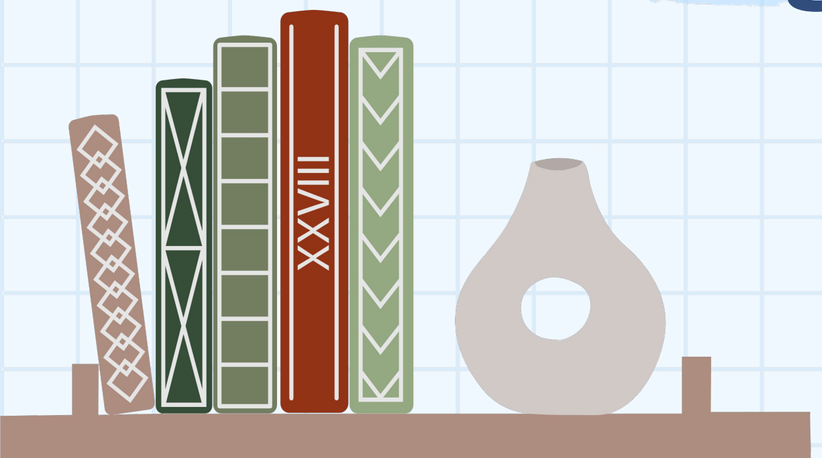
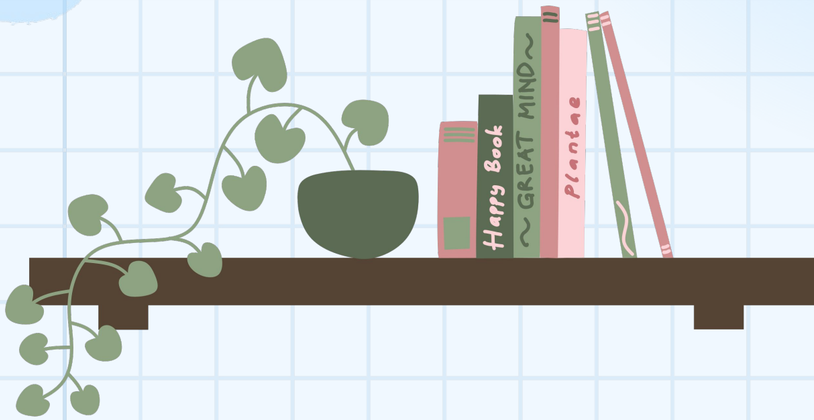
BS./BSC.

Applied AI and Data Science

Algorithmic Thinking & its Applications





Recall: Modules

- Modules provide extra functions, variables
  - **Example**: math provides math.cos(), math.pi
  - Access them with the import command
- Python provides a lot of them for us
- **This Lecture**: How to make modules
  - Pulsar to *make* a module
  - Python to *use* the module

Two different programs

We Write Programs to Do Things

- Functions are the **key doers**

Function Call Function Definition

- Command to **do** the function

```
>>>
plus(23)
24
>>>
```

- Defines what function **does**

```
def plus(n):
    return
    n+1
```

- **Parameter**: variable that is listed within the parentheses of a method header.
- **Argument**: a value to assign to the method parameter when it is called

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Function **Header**

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Function **Header**

Function **Body** (indented)

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We Write Programs to Do Things

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Function Call Function Definition

- Command to **do** the function
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```
>>>
plus(23)
24
```

argument to assign to n

Function **Header**

```
def plus(n):
    return
```

declaration of **parameter** n

Function **Body** (indented)

- **Parameter**: variable that is listed within the parentheses of a method header.
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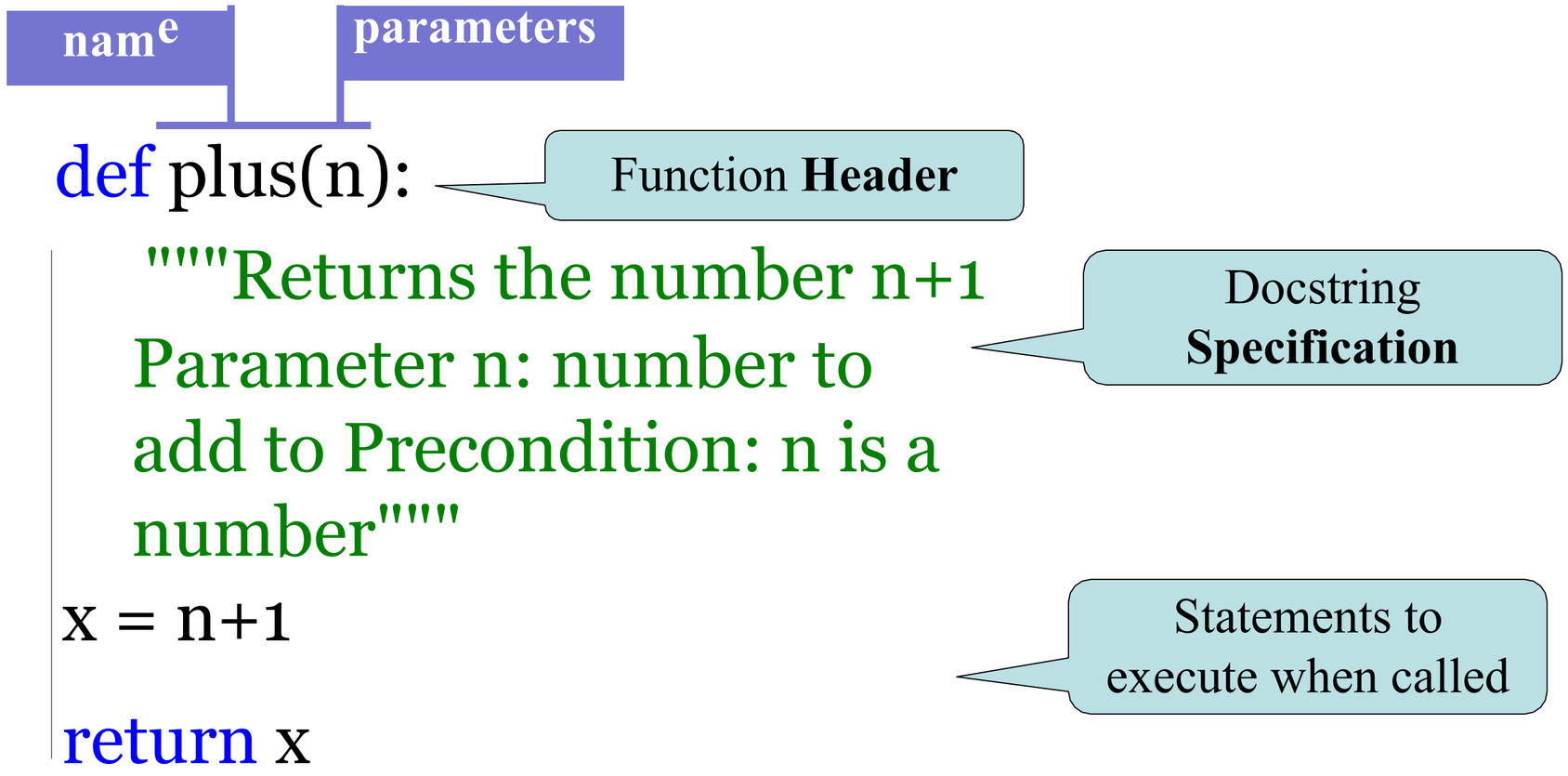
Anatomy of a Function Definition



The return Statement

- **Format**: return <*expression*>
  - Used to evaluate ***function call*** (as an expression)
  - Also stops executing the function!
  - Any statements after a **return** are ignored
- **Example**: temperature converter function

```
def to_centigrade(x):
    """Returns: x converted to
    centigrade""" return 5*(x-32)/9.0
```

A More Complex Example

Function Definition Function Call

```
def foo(a,b):
    """Return something
       Param a: number
       Param b:
       number"""
    x = a
    y = b
    return x*y+y
```

```
>>> x = 2
>>> foo(3,4)
```

x ?

What is in the box?

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What is in the box?

A: 2
B: 3
C: 16
D: Nothing!
E: I do not know

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What is in the box?

A: 2
B: 3
C: 16 **CORRECT**
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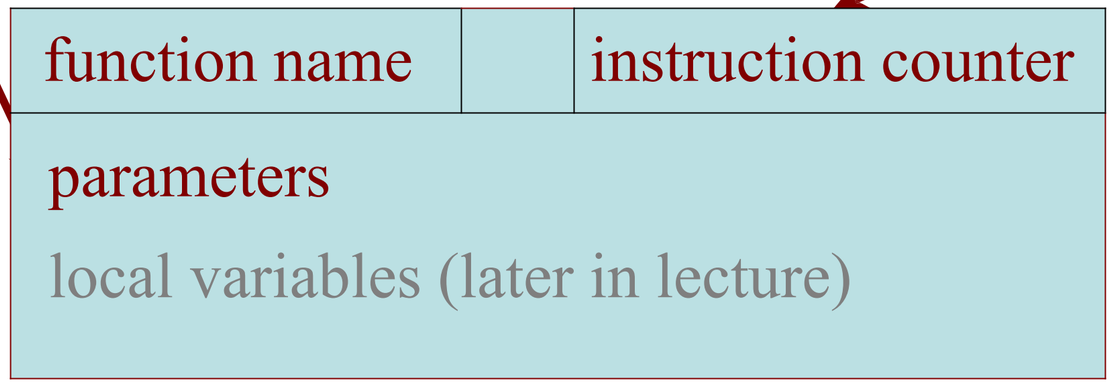
Understanding How Functions Work

- **Function Frame**: Representation of function call
- A **conceptual model** of Python

Draw parameters as variables (named boxes)

- Number of statement in the function body to execute next
- **Starts with line no. of body**



Example: to_centigrade(50.0)

1. Draw a frame for the call
2. Assign the argument value to the parameter (in frame)
3. Execute the function body
   - Look for variables in the frame
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4. Erase the frame for the call

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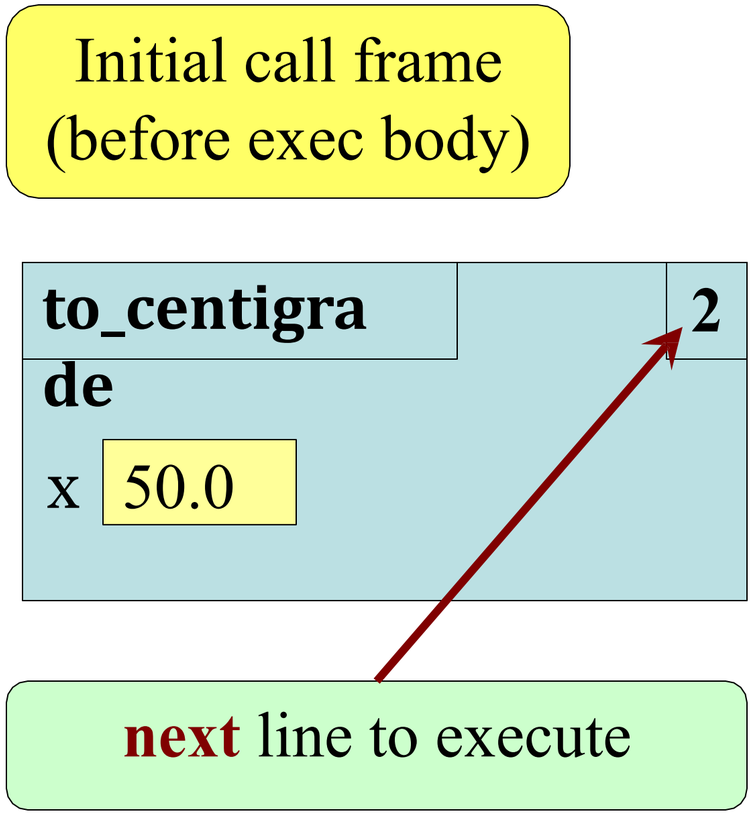

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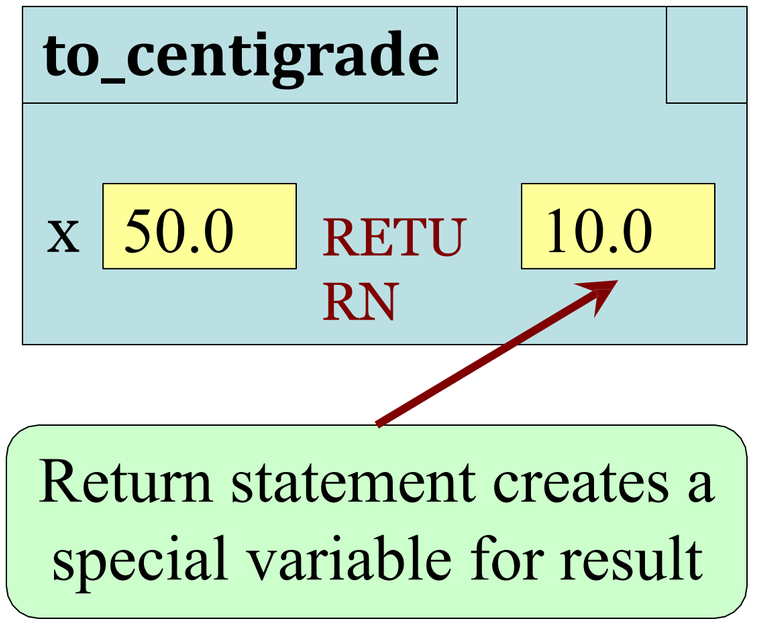
Executing the return statement



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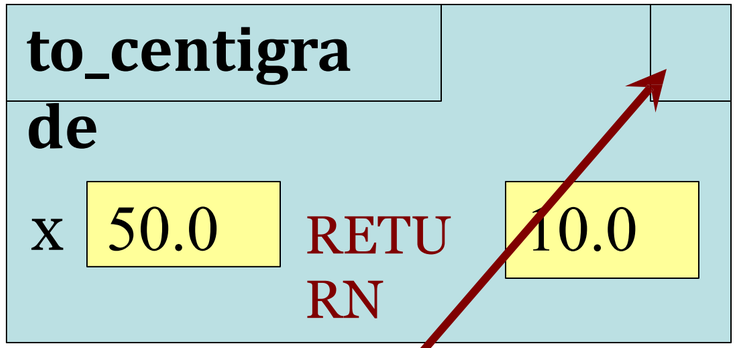

The return terminates; no next line to execute

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ERASE WHOLE FRAME

But don't actually erase on an exam

Call Frames vs. Global Variables

The specification is a **lie**:

```
1  def swap(a,b):
2      """Swap global a &
3      b""" tmp = a
4      a = b
5      b = tmp
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```
>>> a = 1
>>> b = 2
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swap(a,b)
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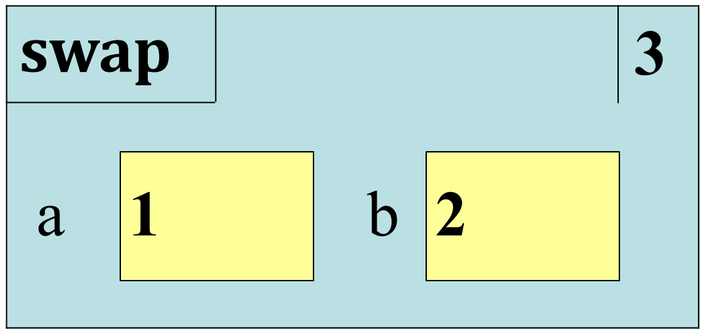
Global Variables

Call Frame



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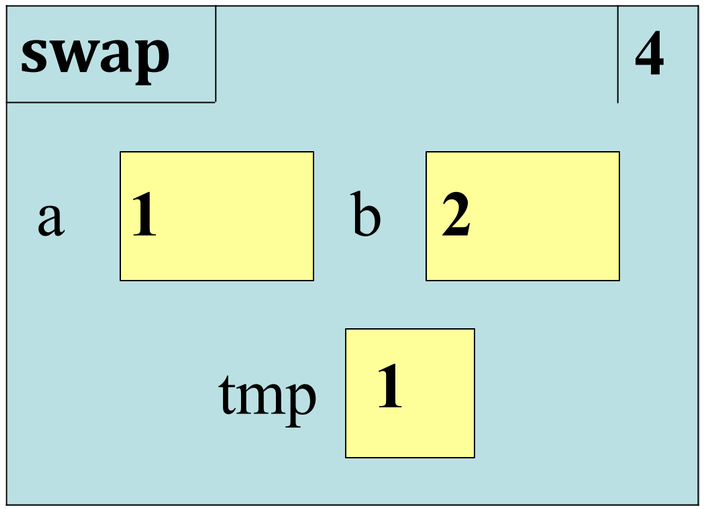

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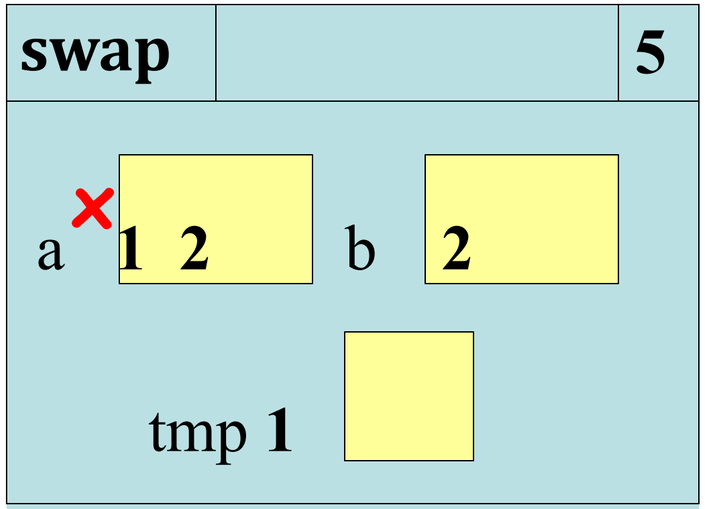

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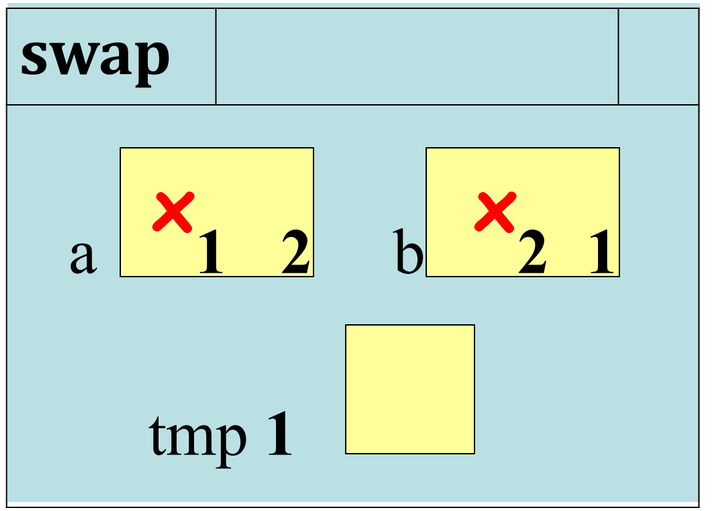

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Call Frame

ERASE THE FRAME

Exercise Time

Function Definition Function Call

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Global Variables

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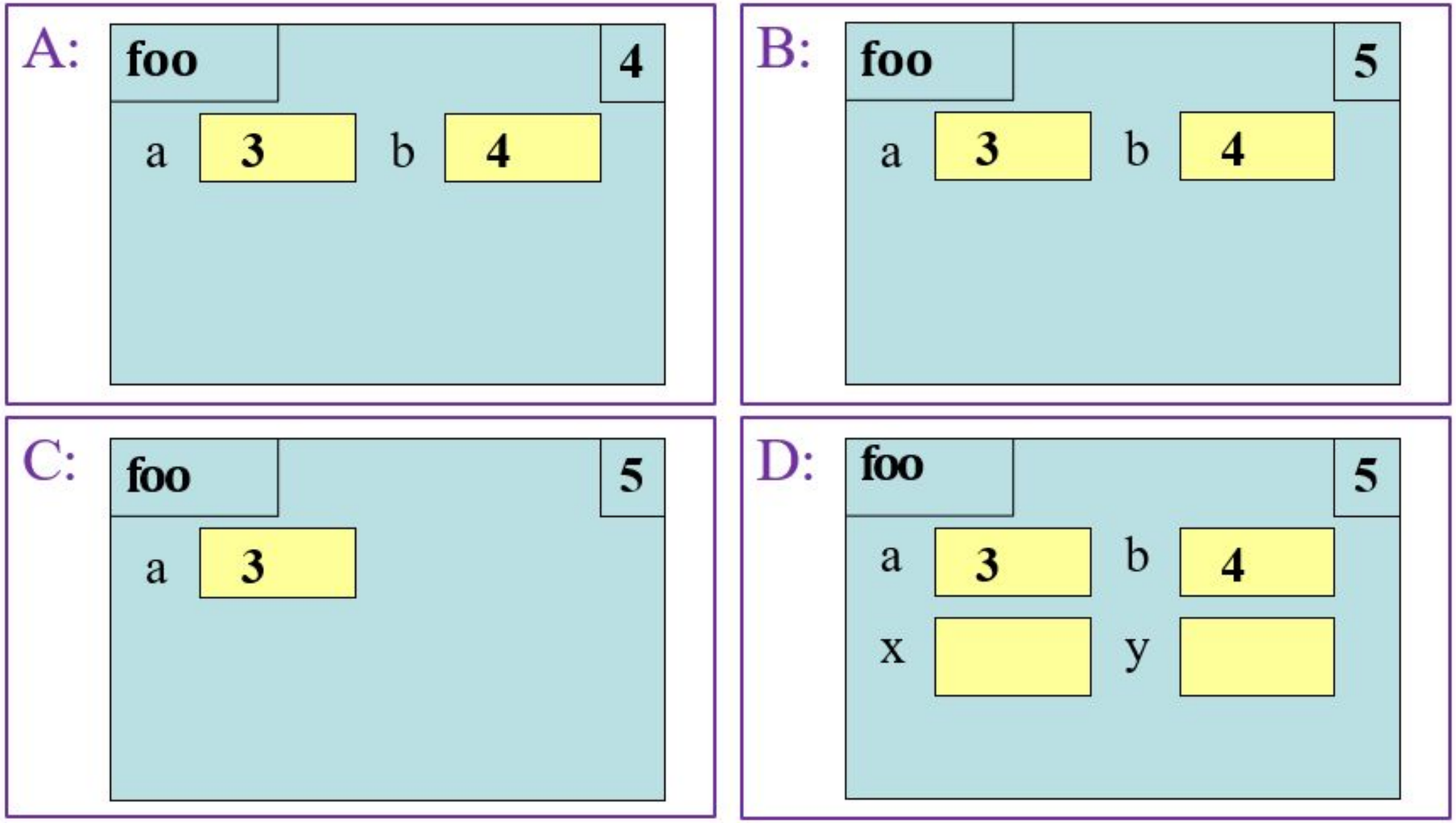
Call Frame

ERASE THE FRAME

Which One is Closest to Your Answer?



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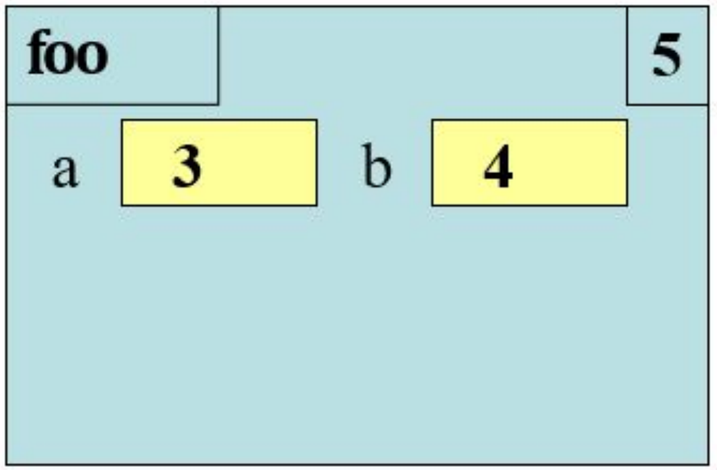

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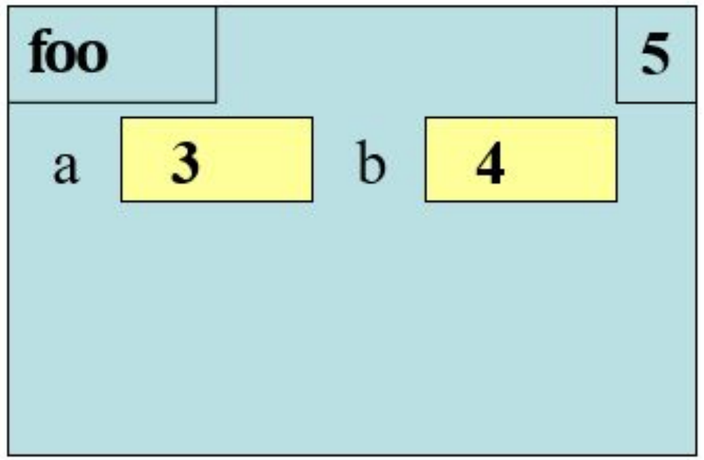
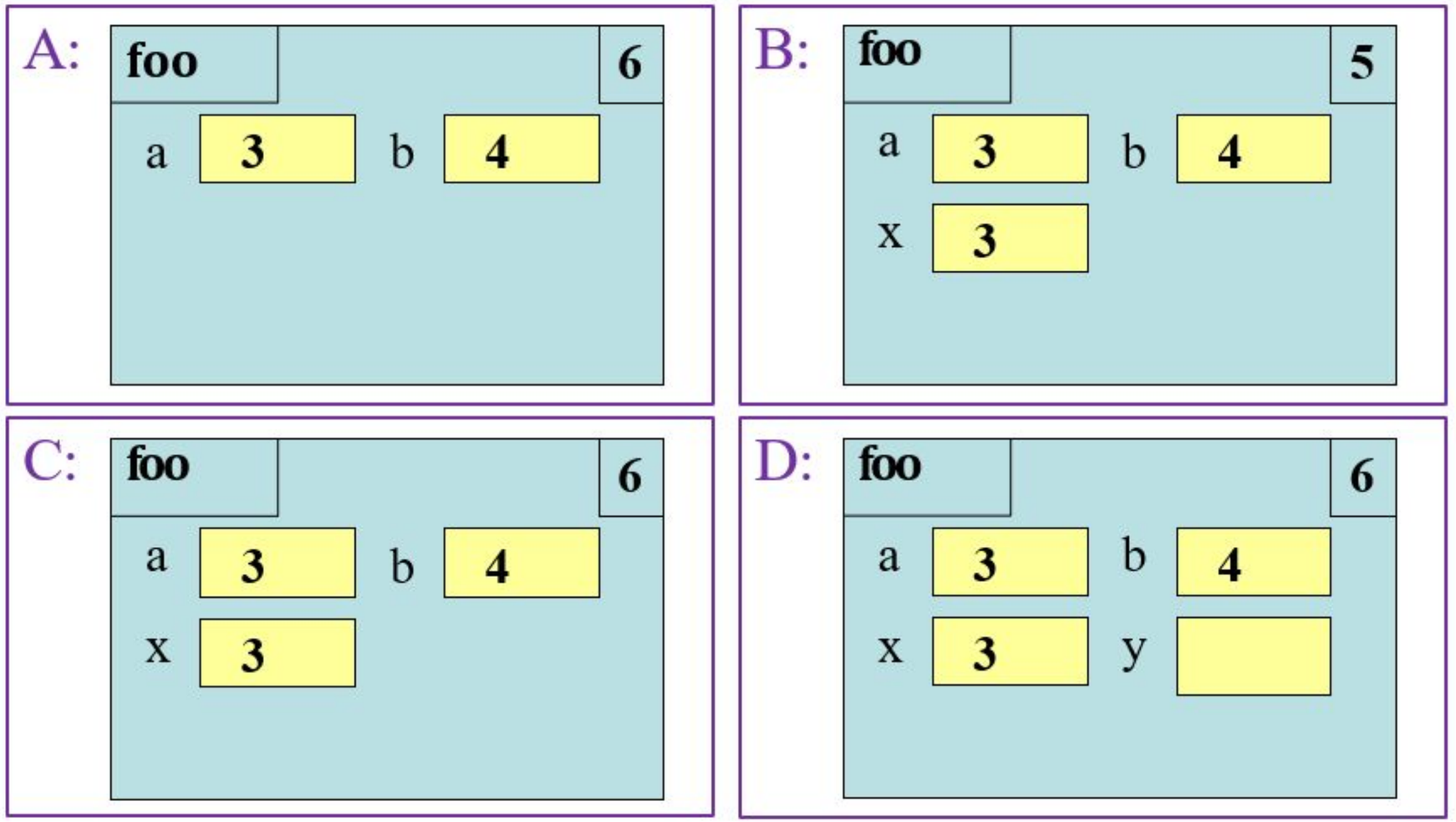


What is the **next step**?

Which One is Closest to Your Answer?



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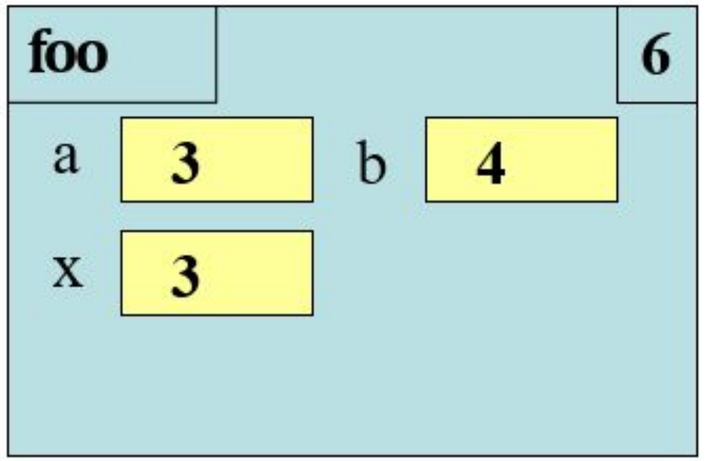

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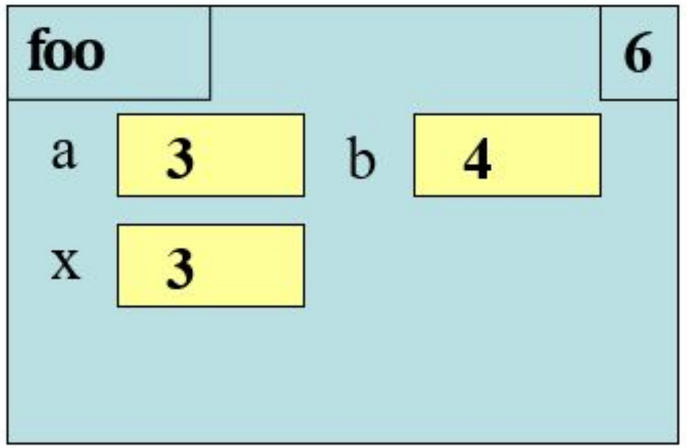

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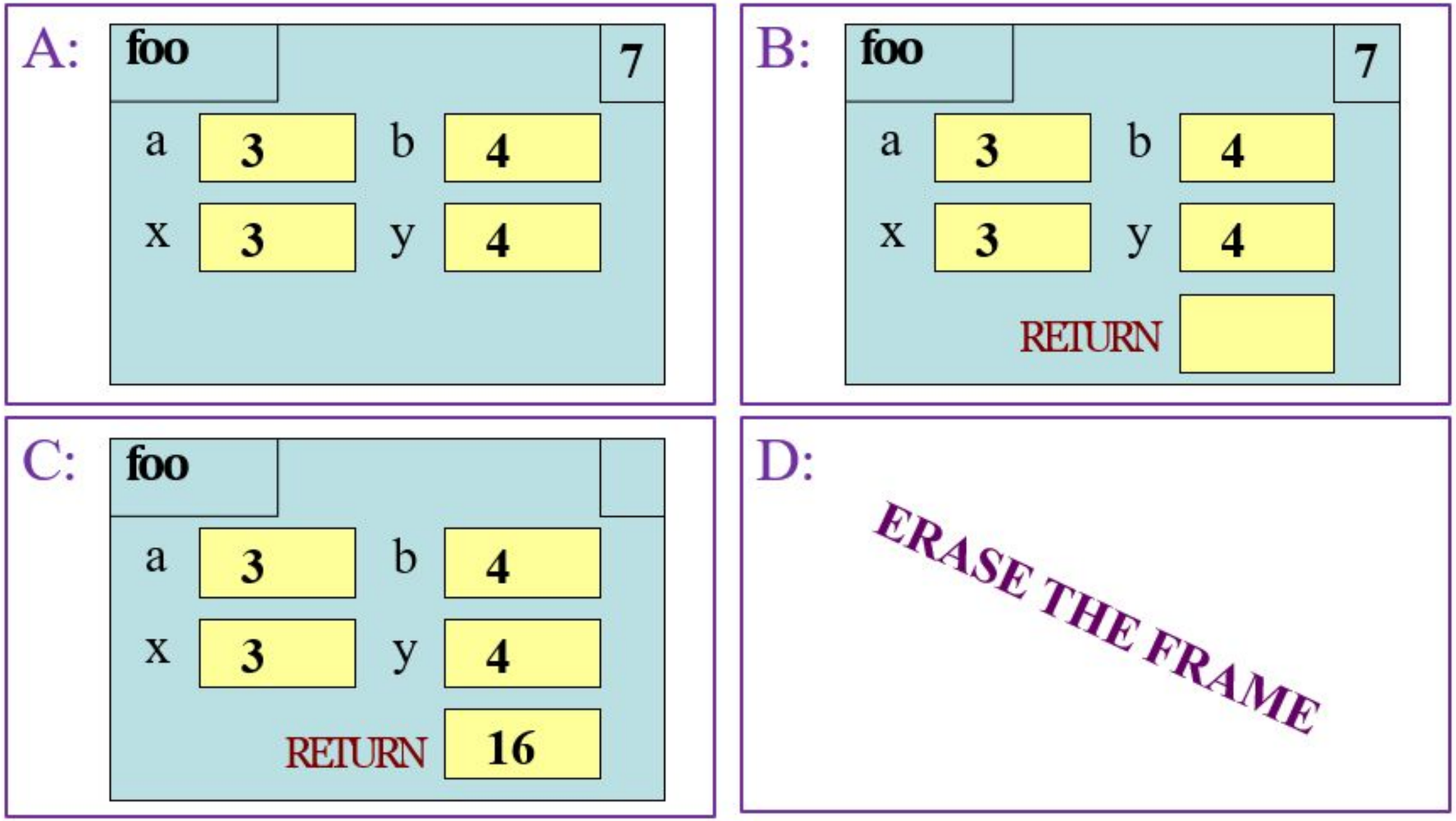
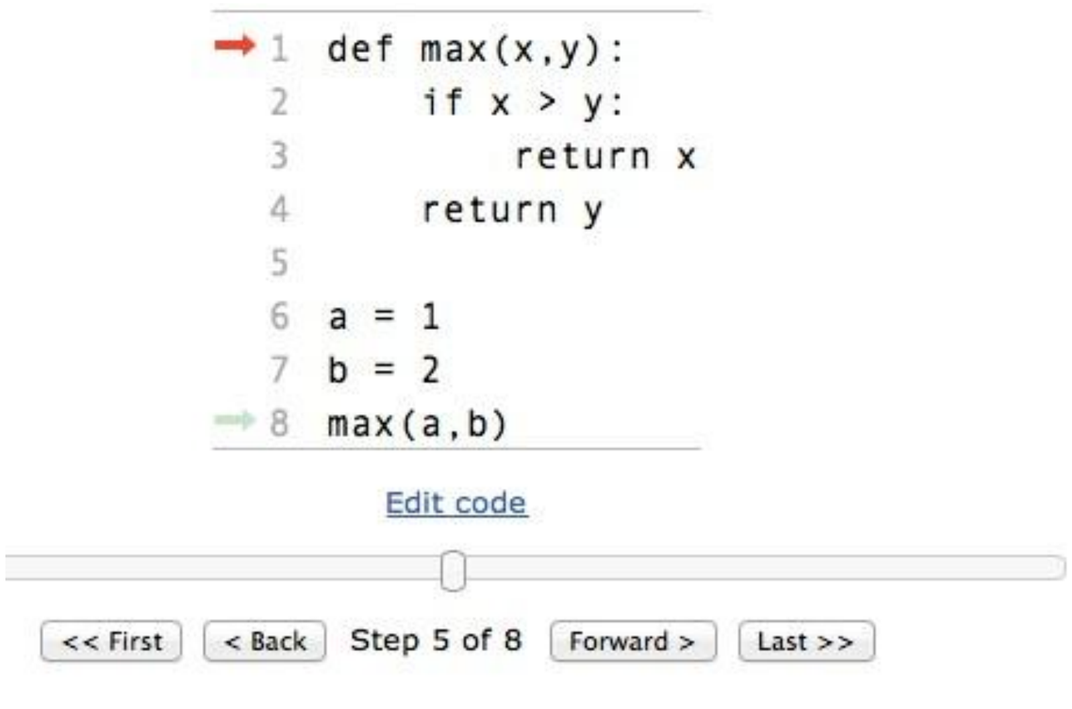


Visualizing Frames: The Python Tutor



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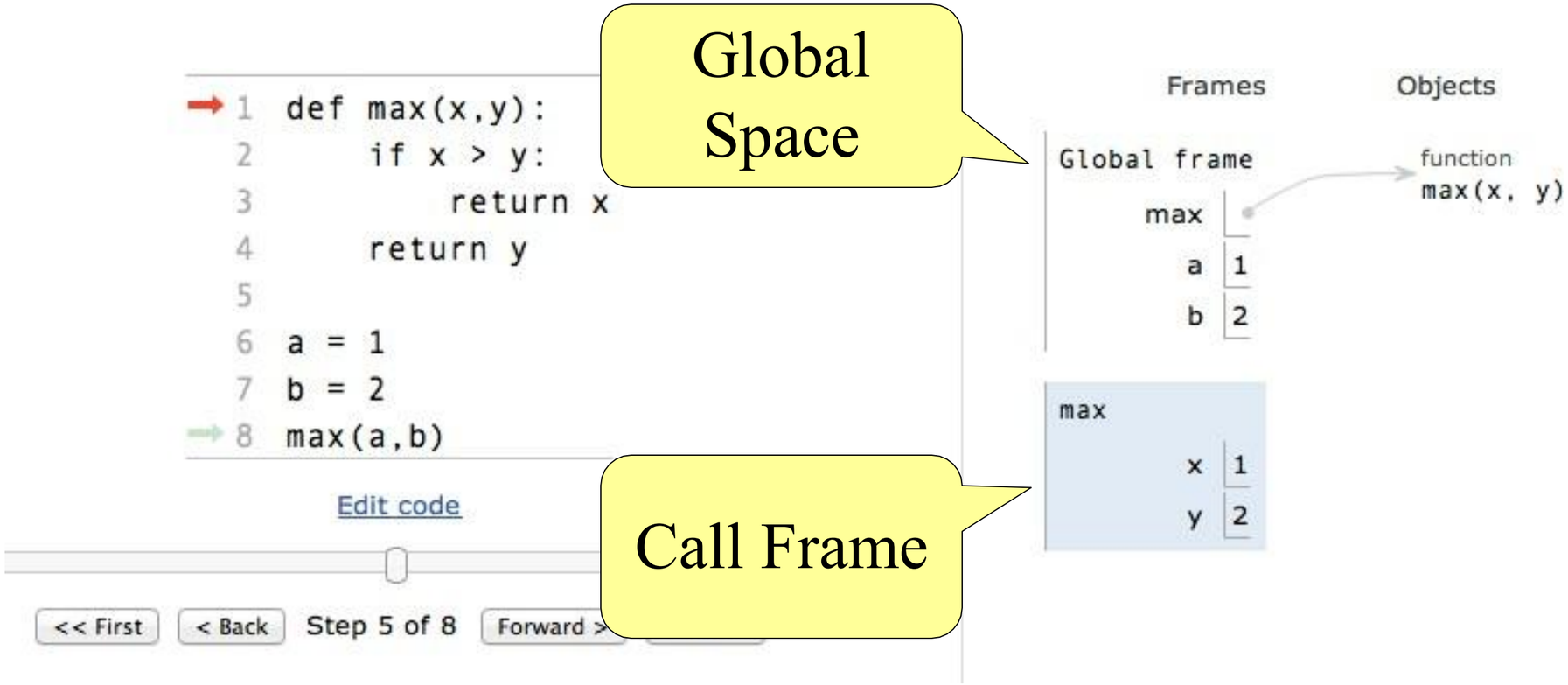

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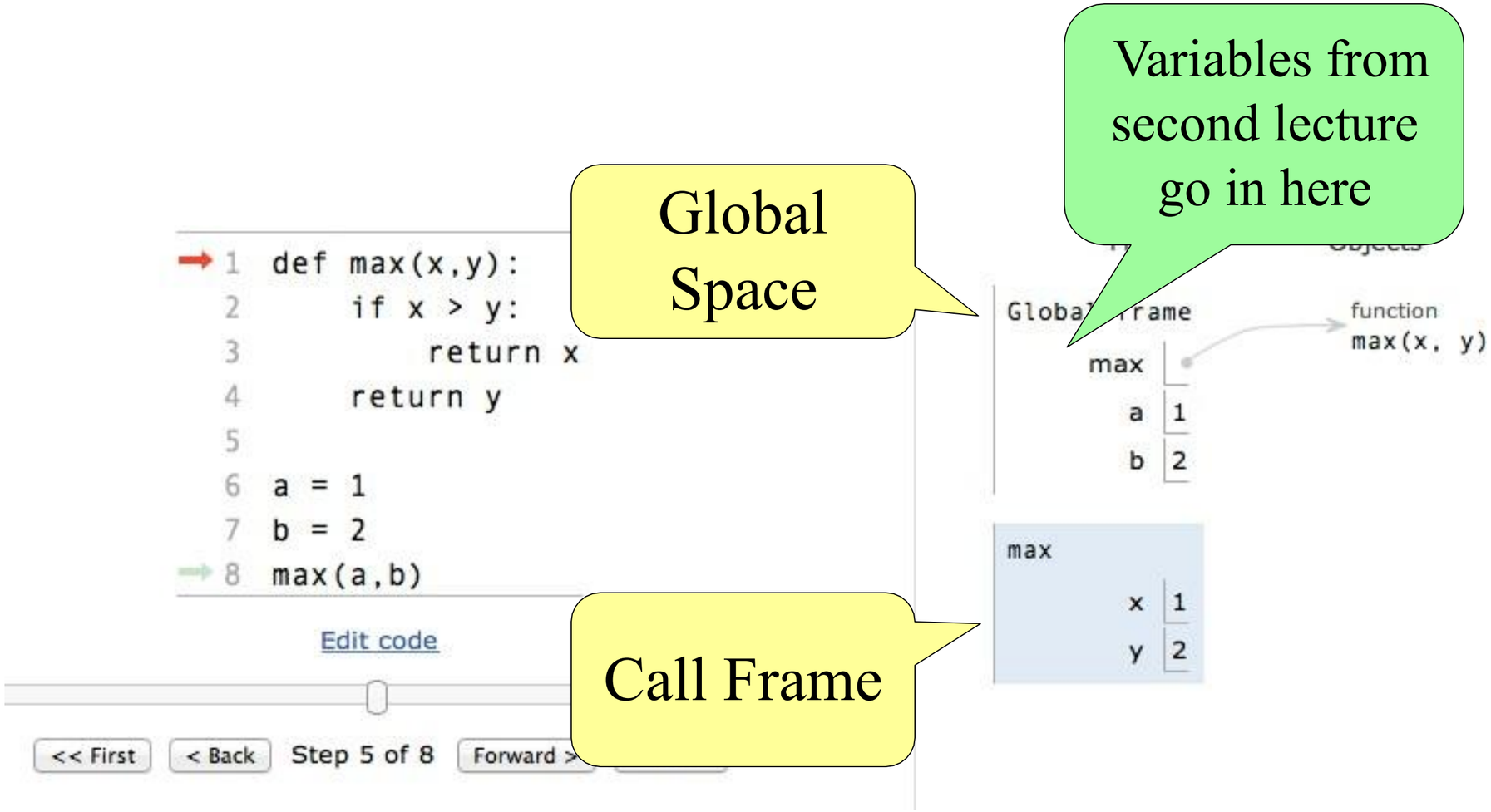

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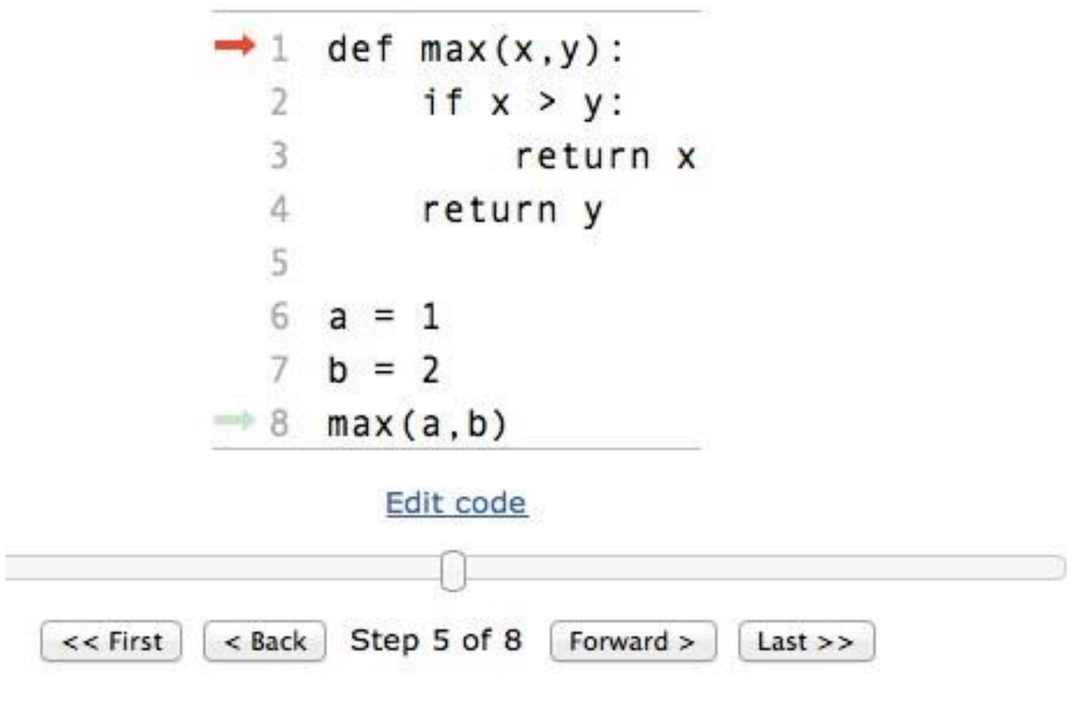

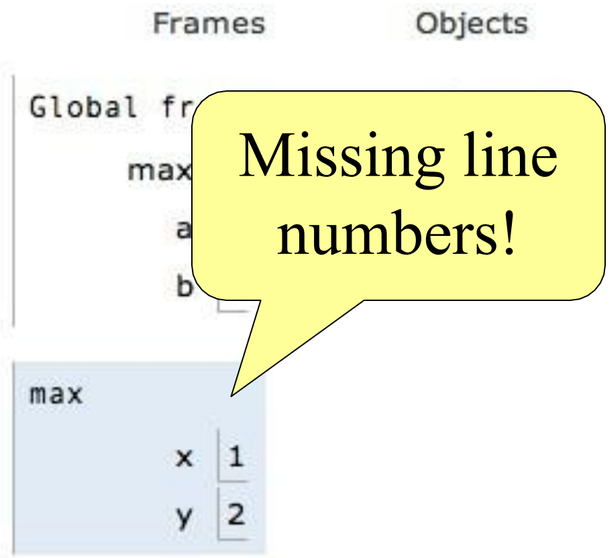

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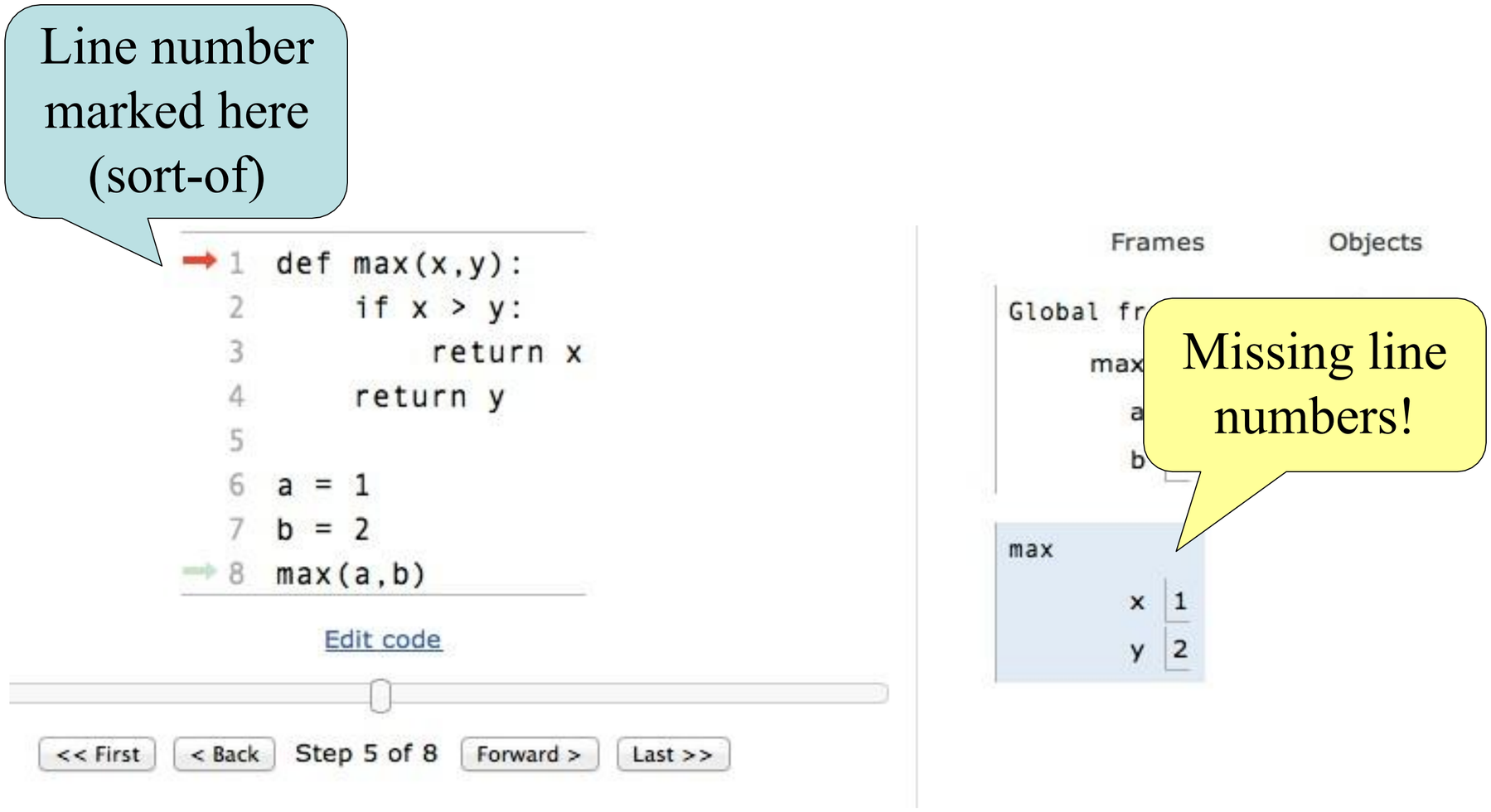

Thank you